BOEING

International Space Station Program

D683-*XXXXX*-1

International Space Station Payload Simulator Requirements Document, Volume I for the *Payload Name (Payload Acronym)*

FINAL DRAFT

October 8, 1996

Submitted To: National Aeronautics and Space Administration
Marshall Space Flight Center
Contract No. NAS8-50000

INTERNATIONAL SPACE STATION

PAYLOAD SIMULATOR REQUIREMENTS DOCUMENT, VOLUME I

FOR *PAYLOAD NAME (PAYLOAD ACRONYM)*

D683-XXXXX-1

OCTOBER 8, 1996

Boeing Defense & Space Group
Missiles & Space Division
(a division of The Boeing Company)
Huntsville, Alabama

PREPARED BY:	_____	_____	_____
CHECKED BY:	_____	_____	_____
APPROVED BY:	_____	_____	_____
DQA:	_____	_____	_____
QA:	_____	_____	_____
SUPERVISED BY:	_____	_____	_____
APPROVED BY:	_____	_____	_____
	(Signature)	(Orgn)	(Date)

(This Page Intentionally Blank)

ABSTRACT

This document presents the payload simulator requirements for the *Payload Name* (*Payload Acronym*) as agreed to by the International Space Station (ISS) Payload Developer (PD) and Marshall Space Flight Center (MSFC) Payload Training Integration Manager (PTIM). This Payload Simulator Requirements Document (PSRD) defines the functional and interface requirements for the *Payload Acronym* simulator that will be developed by the PD and integrated into the Johnson Space Center (JSC) Space Station Training Facility (SSTF)/Payload Training Capability (PTC). This PSRD has been produced by Teledyne Brown Engineering (TBE), contract NAS8-50000. Information for this document has been obtained from the PD, MSFC, and TBE during their respective payload integration activities.

KEY WORDS

Simulator
Payload Training Capability (PTC)
Space Station Training Facility (SSTF)
Requirements
Training Objective (TO)

(This Page Intentionally Blank)

DOC. NO.: D683-XXXXX-1, Final Draft

DOCUMENT RELEASE RECORD (DRR)

RELEASES (& UPDATES)	Update this document by: ACTIVE PAGES	PAGES ADDED	PAGES DELETED	AUTHORIZATIONS (& REMARKS)
October 8, 1996	i thru x 1-1 thru 1-2 2-1 thru 2-2 3-1 thru 3-4 4-1 thru 4-8 5-1 thru 5-6 6-1 thru 6-6 7-1 thru 7-4 8-1 thru 8-4 9-1 thru 9-2 A-i thru A-ii A-1 thru A-2 B-i thru B-ii B-1 thru B-2 C-i thru C-ii C-1 thru C-2 D-i thru D-ii D-1 thru D-2			Initial release

(This Page Intentionally Blank)

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF FIGURES

LIST OF TABLES

(This Page Intentionally Blank)

SECTION 1, INTRODUCTION

This document is the Payload Simulator Requirements Document (Volume I) for the *Payload Acronym payload facility, lab support equipment, long-term payload* that will be resident onboard the ISS. This document contains the simulator specific requirements for a payload simulator that will reside at the SSTF/PTC to support training for the Payload Crew, the Payload Operations Integration Center (POIC) cadre, the Mission Control Center - Houston (MCC-H) flight controllers, and the Payload Developer (PD) teams as directed by the payload complement Training Strategy Team (TST) and documented in the Payload Complement Training Plan (PCTP).

Requirements for the SSTF/PTC facility and its interfaces to payload simulators are contained in the Payload Users Development Guide (PUDG), SST-427, *PUDG date*. The PSRD, in conjunction with the PUDG, should provide the *Payload Acronym* PD with all of the information required to build a simulator for the SSTF/PTC.

1.1 PURPOSE

The purpose of the PSRD Volume I is to define the physical, functional, and interface requirements necessary to support PTC training for the *Payload Acronym* payload that will become part of the ISS payload complement. Volume II, to be published at a later date, will provide the installation, checkout, and maintenance procedures for the *Payload Acronym* simulator. The simulator developed from these requirements will be used at the SSTF/PTC to conduct Payload Orientation *(if available)*, Payload Familiarization *(for non-facility)*, Payload Transport *(if applicable)*, Payload Transfer *(if applicable)*, Payload Proficiency *(for non-facility)*, Payload Refresher, Payload Support, Crew Payload Complement, Crew Multi-Segment, Integrated Payload Complement, and Joint Multi-Segment training sessions for the payload crew, ground controllers, POIC cadre, and PD teams. This document identifies the basic Training Objectives (TO) that will be supported by the simulator; the approach used to develop the simulator; the parties responsible for providing the simulator hardware and software components; and the parties responsible for integrating, operating, and maintaining the simulator (as defined in Volume II). PSRD Volumes I and II serve to document agreements between the MSFC Payload PTIM, the PD, and the SSTF/PTC concerning the payload simulator.

1.2 SCOPE

This PSRD is divided into nine major sections and four appendices.

- Section 1, “Introduction”, provides the purpose and scope of this document.
- Section 2, “Applicable Documents”, list the documents that were referenced in the development of this PSRD.
- Section 3, “Flight Description”, provides a description of the *Payload Acronym* facility/payload, its science objectives, flight interfaces, and an overview of its operations.

- Section 4, “Simulator Overview”, identifies the simulator TOs and gives an overview of the simulator that will be required to meet these objectives.
- Section 5, “*Payload Acronym* Interfaces to the SSTF/PTC”, discusses both the hardware interfaces between the simulator and the SSTF/PTC and the simulated interfaces between the simulated payload and the SSTF core systems simulators.
- Section 6, “*Payload Acronym* Simulator Software Requirements”, specifies the capabilities required for the simulator software to operate within the SSTF/PTC simulation environment.
- Section 7, “Simulator Hardware Mockup Requirements”, provides the requirements for the rack mounted hardware, stowage hardware, and simulator interface hardware.
- Section 8, “*Payload Acronym* Flight Software Utilization Requirements”, defines the command and data interfaces between the simulator and the Payload Executive Processor, and also defines the Portable Computer System (PCS) displays used by *Payload Acronym.*
- Section 9, "Simulator Development and Verification Process", defines the development and verification phases that are involved in creating the *Payload Acronym* simulator.
- Appendix A lists the abbreviations and acronyms used in this document.
- Appendix B provides the definition of the simulator class levels.
- Appendix C provides the specifications for the simulator connector cables.
- Appendix D provides the Payload Simulator Interface Definition Forms.

SECTION 2, DOCUMENTS

The following references may include documents, specifications, standards, guidelines, procedures, handbooks and other special publications. These documents, of the exact issue shown form a part of these requirements to the extent specified herein. Unless the exact issue and date are identified, the "Current Issue" cited in the contract Applicable Documents List applies. Inclusion of applicable documents herein does not in any way supersede the contractual order of preference.

2.1 APPLICABLE DOCUMENTS

DOCUMENT NUMBER DATE/ISSUE	**TITLE**
A. Government Standards	
document # *document date*	*List all government standards documents that were used in preparing this document.*
B. Industry Standards	
document # *document date*	*List all industry standards documents that were used in preparing this document.*
C. NASA - MSFC Documents	
document # *document date*	*List any MSFC documents that were used in preparing this document.*
D. NASA - JSC Documents	
SST-427 *PUDG date*	Payload User Development Guide (PUDG) for the Space Station Training Facility/Payload Training Capability
document # *document date*	*List all other JSC documents that were used in preparing this document.*
E. Boeing Documents	
D683-43033 *ITP date*	All Flights Payload Integrated Training Plan (ITP)
document # *document date*	*List all other Boeing documents that were used in preparing this document.*

(This Page Intentionally Blank)

SECTION 3, FLIGHT DESCRIPTION

The *Payload Acronym* payload is a *life science/materials science* payload configured for an *International Standard Payload Rack (ISPR)/Expedite the Processing of Experiments to Space Station (EXPRESS) rack. Add some general words about how many racks/drawers are used, whether any stowage is used, or any other general layout information.*

The following sections give a description of the flight *Payload Acronym facility/payload* and its in-flight operations. This section of the PSRD does not levy any simulator requirements and is included only as background and reference information to aid in the understanding of the *Payload Acronym* payload and the simulator requirements defined later in this PSRD.

3.1 *PAYLOAD ACRONYM* SCIENCE OBJECTIVES

This section gives a brief description of the desired science objectives of the payload*. It can either state the general science objectives for a payload facility, or give the science objectives of specific facility users on an increment specific payload.*

3.2 *PAYLOAD ACRONYM* HARDWARE DESCRIPTION

This section provides flight descriptions of the payload hardware elements. *If appropriate, this can be broken down into a subsection for each element, i.e., 3.1.1, 3.1.2.*

3.3 *PAYLOAD ACRONYM* HARDWARE ARRANGEMENT AND INTERFACES

This section provides a brief description of how the *Payload Acronym* hardware will be configured in the U.S. Lab and includes configuration drawings (*if available*) that show where the payload is mounted in the racks and how it fits into the lab relative to the other facilities/stowage locations. As part of this description, Figure 3-1 is included to show the layout of the rack(s) and how the hardware is arranged within them. *Several drawings can be used if necessary to show multiple racks or separate hardware items and how they interface to the racks.*

Provide a brief description of the interfaces required by Payload Acronym, i.e., electrical power, data, special mounting requirements, etc.

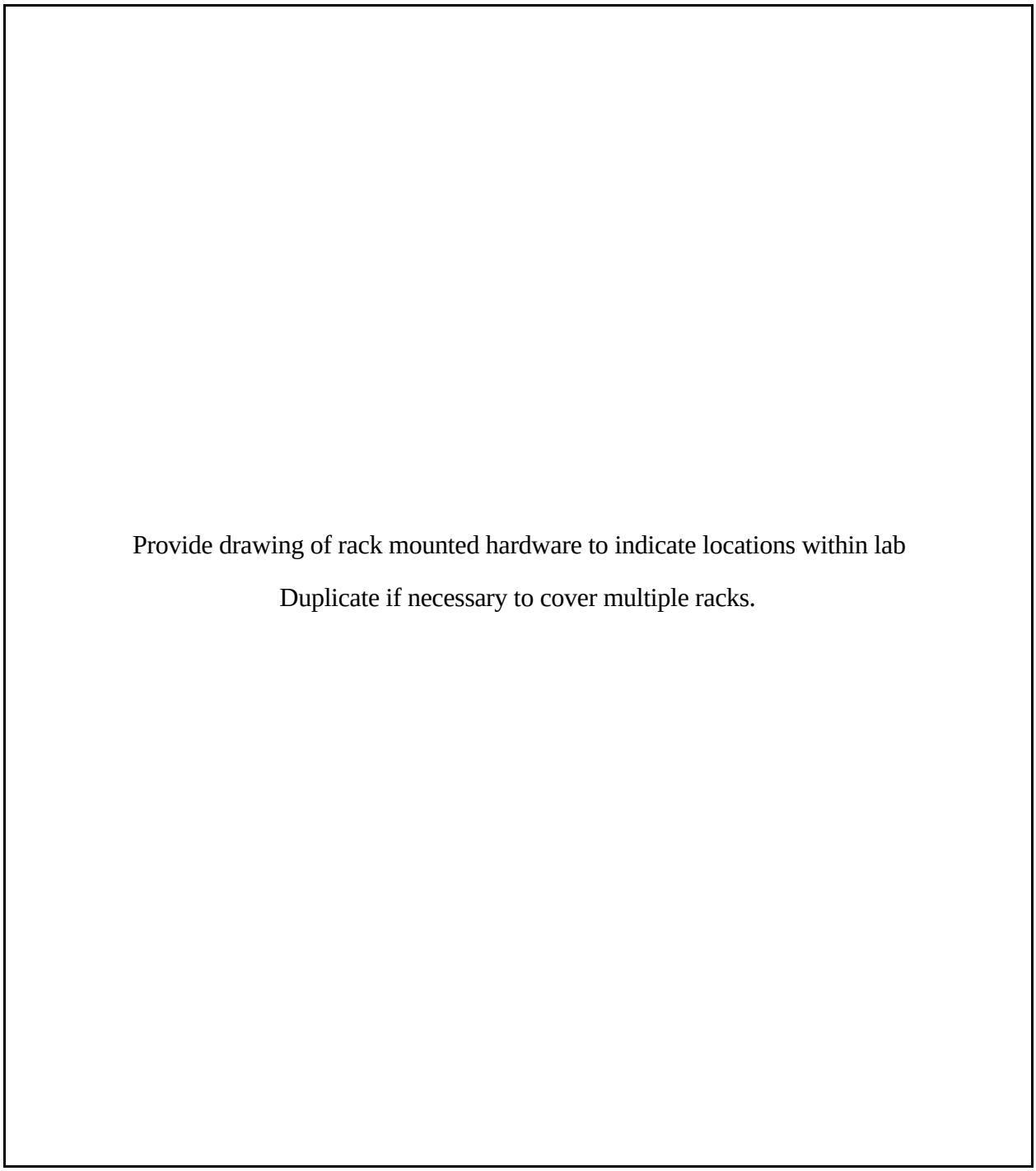

FIGURE 3-1 PAYLOAD LAYOUT

3.4 *PAYLOAD ACRONYM* FLIGHT PORTABLE COMPUTER SYSTEM USAGE

This section provides a brief description of the ISS Portable Computer System (PCS) resources used by *Payload Acronym (displays, caution and warning indications, automated operations, etc.). Note that this section can be included under 3.3 if brief.*

3.5 *PAYLOAD ACRONYM* FLIGHT OPERATIONS SUMMARY

This section provides a brief description of *Payload Acronym* payload operations including all known crew operations. *Provide a list of the nominal operations, alternate operations, and any malfunction operations that have been defined.*

(This Page Intentionally Blank)

SECTION 4, SIMULATOR OVERVIEW

The *Payload Acronym* simulator that will be developed for the SSTF/PTC is intended to provide the capability to exercise flight crew procedures to meet the TOs defined later in this section. This simulator will provide the crew with an opportunity to receive flight-like feedback; recognize visual nomenclature and graphics; realize reach constraints; and manipulate parts, loose items and stowage; all while operating within the constraints of the ISS Lab environment. The simulator will be designed such that training sessions can include both nominal and malfunction operation scenarios. This simulator will also accept commands and provide housekeeping data for ground team training during joint training sessions involving the MCC-H, POIC, and/or User Operations Facility (UOF) sites.

4.1 TRAINING OBJECTIVES

The TOs for *Payload Acronym* have been identified and defined through the TST process. The specific TOs that place a requirement on the *Payload Acronym* simulator are summarized in Table 4-I. Also included in Table 4-I are the simulator elements which will be used to satisfy each TO.

4.2 SIMULATOR UTILIZATION

Training using the *Payload Acronym* simulator falls into *eleven* categories: Payload Orientation *(if available)*, Payload Familiarization *(for non-facility)*, Payload Transport *(if applicable)*, Payload Transfer *(if applicable)*, Payload Proficiency *(for non-facility)*, Payload Refresher, Payload Support, Crew Payload Complement, Crew Multi-Segment, Integrated Payload Complement, and Joint Multi-Segment. These training categories are described in the following sections.

4.2.1 Payload Orientation

Payload Orientation is training for the crew which consists of two basic elements: Individual Payload Orientation and Payload Complement Orientation.

Individual Payload Orientation training consists of a basic introduction to a single payload element at the SSTF/PTC. The objective of this training will be to acquaint the crew with a payload element prior to traveling to a PDC/User site for more in-depth training. The orientation for a specific payload may include a classroom presentation, Computer Based Training (CBT) modules, training videos, and/or use of the SSTF/PTC Payload Training Simulator (PTS). The availability of training resources, such as a PTS from a previous increment, will determine the appropriate medium(s) for the orientation. The instructor will generally be a JSC Instructor (DT). Whenever possible, Individual Payload Orientation will occur during the Advanced Training phase prior to crew travel to the PDC/User Site for training on generic facility tasks.

TABLE 4-I *PAYLOAD ACRONYM* TRAINING OBJECTIVES

NOMINAL OPERATIONS	SIMULATOR ELEMENT
TO-1: *training objectives should consist of specific tasks the crew will have to be trained on in order to perform payload/facility operations.*	
TO-2: *Examples would include things such as facility activation, mounting a payload chamber, or initiating a payload run.*	
TO-3: *Operations that are the same for several payload runs (i.e. mounting a payload chamber in the facility) only constitute one TO. However, tasks such as sample fixation, that can be different depending upon the biological sample in question, are separate TOs.*	
MALFUNCTION/ALTERNATE OPERATIONS	SIMULATOR ELEMENT
Malfunction/alternate operations are specific operations that are used to correct a given failure within the payload/facility.	
Malfunctions need to be included that support all of the expected crew procedure malfunctions.	

Payload Complement Orientation training consists of an introduction to the entire payload complement for a specific increment. The orientation should occur at the SSTF/PTC and serves as a "kick-off" to Increment-Specific Training. The objective of this training will be to provide the crew with a summary of payload elements, a description of increment payload resources and configuration, an introduction to key payload operations personnel, and an introduction to payload training personnel and schedules. This orientation will consist of classroom presentations and a walk-through of the lab environment. The Payload Training Integration Manager (PTIM) shall conduct this orientation with assistance from POIF personnel, Simulation Engineers, and JSC Instructors.

4.2.2 Payload Familiarization Training

Payload Familiarization training is conducted on a single payload to provide the crew with an overview of the payload and an introduction to payload operations. This training shall provide the crew with a facility overview (for facility class payloads); payload science background and applications (for single payloads); a payload systems overview; an operations overview; and a familiarization of nominal and malfunction/maintenance operations. Typically a classroom presentation will be utilized to cover overviews of the facility/science, payload systems, and operations. Hands-on training will be conducted to allow the crew to actually perform the nominal and malfunction/maintenance procedures which may be performed onboard the Space Station. Training on Lab Support Equipment (LSE) will be included, as required, to support specific payload operations tasks. Certain payload-specific transfer activities will also be performed at this time. If the station crew will also be involved in operation of the payload while on the transport vehicle then transport procedures will also be addressed. This first time walk-through of detailed procedures will allow the crew to begin proficiency-building on all tasks associated with nominal and malfunction/maintenance operations.

Choose the specific type and location of training specified in the following paragraph for Payload Acronym situation.

For all U.S. Facility Class payloads or Partner Facility Class payloads in the U.S. Lab, Payload Familiarization training will occur at the PDC/User site and the instructor will be the Payload Developer (PD). For all other U.S. payloads (EXPRESS long-term, EXPRESS short-cycle, etc.), Lab Support Equipment, and Partner EXPRESS payloads in the U.S. lab, Payload Familiarization training will generally occur at JSC. For long-term payloads there will most likely be a PTS resident at the SSTF/PTC to support Payload Familiarization training. For short-term payloads the payload training medium (i.e., PTS, flight back-up unit, front-panel mockup) will determine if this training will occur in the SSTF/PTC or another appropriate site at JSC. The instructor for this will be an SE/DT and/or the PD depending upon the location of the training and complexity of the operations.

4.2.3 Payload Transport Training

Payload Transport training instructs the crew on all nominal and malfunction operations which may be performed while the payload is onboard the transport vehicle (i.e., Space Shuttle, Soyuz). While Payload Familiarization training is directed at the station crew, Payload Transport training is performed for the crew of the transport vehicle (which may or may not be the same as the station crew members). This training may include a brief classroom overview of the major payload elements and transport operations. Hands-on training will be performed

to begin building the crew's proficiency on all nominal, maintenance, malfunction, and alternate procedures that are associated with transport operations.

Choose the specific type and location of training specified in the following paragraph for Payload Acronym situation.

NASA Payload Transport training may be performed at either the PDC/User site or JSC, depending upon the complexity of transport operations, the availability of training hardware at JSC, and whether the station and transport vehicle crews consist of the same or separate crew members. As discussed in the previous section, if the station crew is also the crew of the transport vehicle then transport training can be folded into Payload Familiarization training. If the crews are distinct then locations for this training will be determined by the criteria defined above. The SE/DT and/or PD will conduct this training dependent upon the location of the training and complexity of the operations.

4.2.4 Payload Transfer Training

Payload Transfer training familiarizes the crew with the activities that must be performed to transfer unique payload equipment from the transport vehicle to the Space Station, install this equipment in the appropriate laboratory location, and perform check-outs on the payload equipment inside the station environment. This training may be directed at either the station or transport vehicle crew, dependent on the defined operator for the transfer activities. The Payload Transfer training may include a classroom overview as well as hands-on training to introduce the crew to detailed procedures and begin proficiency-building on these tasks. Note that generic tasks associated with the transfer of ISPRs, lockers, and other standard equipment will be accomplished during the Advanced Training phase in the SSMTF at JSC.

Choose the specific type and location of training specified in the following paragraph for Payload Acronym situation.

NASA training on the payload-specific transfer and installation activities will be performed in the SSMTF using either mockups designed specifically for this purpose or training hardware borrowed from the SSTF/PTC. Training on check-out activities will be introduced during the Payload Familiarization training described above or as part of a separate training activity. The location of this check-out training is dependent upon the location of these other training activities, the complexity of the check-out operations, and the fidelity of training equipment at JSC. Payload Transfer training will be conducted by the SE/DT and/or the PD dependent upon the location of the training and complexity of the operations.

4.2.5 Payload Proficiency Training

Payload Proficiency training consists of a review of nominal and malfunction/ maintenance procedures; transport activities; and payload-specific transfer operations for a single payload. The objective of this training is to maintain the crew members' proficiency in performing detailed payload operations. Power-up/power-down, activation/deactivation, preventive maintenance, processing, support equipment, transport, and payload-specific transfer activities are performed to maintain proficiency in nominal payload operations. Off-nominal scenarios are included in this training to maintain the crew members' skills in the definition and recognition of possible failures, the implications for continued operations, and

the performance of malfunction, alternate, and corrective maintenance procedures. Payload Proficiency training may include both station and transport vehicle crew, dependent upon the defined operator for specific transfer and transport tasks. The primary medium for Payload Proficiency training is hands-on, although classroom sessions are utilized to tabletop procedures, review and status configuration changes, and debrief training sessions. Payload Proficiency training will be repeated at predefined intervals to meet currency requirements, as defined by the PTIM.

Choose the specific type and location of training specified in the following paragraph for Payload Acronym situation.

NASA Payload Proficiency training is conducted at the PDC and/or the SSTF/PTC. This training shall be performed by the SE/DT and/or PD dependent upon the location of the training and complexity of the operations. Some portions of the proficiency training for payload-specific transfer tasks may also be performed at the SSMTF.

4.2.6 Payload Refresher Training

Payload Refresher training is crew training conducted on an individual payload at the request of the crew (station or transport vehicle), PTIM, or instructor (SE, DT, or PD). These sessions are not part of the planned curriculum for a given payload. Payload Refresher training is added after completion of the planned curriculum to give the crew additional training on a given payload or particular aspects of a payload. NASA Payload Refresher training is generally conducted at JSC by the SE/DT. PD-provided refresher training may be requested at the PDC/User site depending upon the nature of the operations.

4.2.7 Payload Support Training

Payload Support training provides the station crew with detailed instruction on the use of integrated products for a specific payload complement. This training will familiarize the crew with the onboard procedures that are focused on nominal operation of the integrated payload complement and integrated contingency resolution. Examples of these activities include rapid safing of the payload complement, payload complement response to system failures, and usage of station systems and support equipment by the payload complement. Classroom sessions will provide the crew with an introduction and review of individual integrated products. Hands-on training will allow the crew to walk-through detailed procedures within the lab environment.

NASA Payload Support training for the U.S. payloads/segment will be conducted in the SSTF/PTC by POIF-provided instructors. Payload support training for the entire ISS payload complement shall also be conducted in the SSTF/PTC to exercise integrated products across multiple segments. This training shall be performed by a combination of POIF and Partner-provided instructors.

4.2.8 Crew Payload Complement Training

Payload Complement training for the station crew is conducted on combinations of payloads and support equipment/activities (i.e., stowage, communications outages, status reporting, etc.) relative to the increment timeline. These sessions will focus on the execution of

both individual and integrated payload procedures. These sessions will build and maintain the crew's proficiency at operating suites of payloads in their flight environment consisting of other payloads, subsystem interfaces, and ground communications.

Payload Complement training for the U.S. payloads/segment will be conducted at the SSTF/PTC using payload simulators and ISS subsystem simulators in a supporting role. Simulation Engineers and/or DT will conduct this training. Payload Complement training for the entire ISS payload complement will also be conducted at the SSTF/PTC. This training will exercise the increment timeline across segments and focus upon activities critical to overall ISS payload operations. Simulation Engineers, DT, and/or Partner-provided instructors will conduct this training. POIC GSP may support this training, on a limited basis, via the Remote Area for Payload Support (RAPS) consoles located at MSFC's UDC.

4.2.9 Crew Multi-Segment Training

Multi-Segment training for the station crew is conducted on combinations of payloads and ISS systems across segments. The focus of multi-segment training shifts from the payload complement to the ISS subsystems in all segments. The payload training received at this point is secondary as malfunctions are introduced to the ISS subsystems and their effects are passed on to the payloads.

Multi-Segment crew training will be conducted at the SSTF/PTC by DT. MSFC training personnel will support this training via the RAPS.

4.2.10 Integrated Payload Complement Training

Integrated Payload Complement Training is conducted to exercise crew and ground personnel on the processes and procedures supporting operations of the payload complement and support equipment/activities. The objective of this training is to provide a simulation environment in which the crew and all GSP dedicated to payload operations can exercise payload specific interfaces and procedures in a flight-like environment.

NASA Integrated Payload Complement Training will include the station crew, POIC cadre, U.S. Users, and Partner GSP dedicated to payload operations. The station crew will participate from the SSTF/PTC and will interact with the payload and system simulators resident there. Data, commanding, video, and voice interfaces will be extended from the SSTF/PTC to the POIC, and then to the respective User and Partner sites. The MSFC Simulation Director and MSFC Simulation Supervisor plan and conduct these simulations with the assistance of Simulation Engineers.

4.2.11 Joint Multi-Segment Payload Training

Joint Multi-Segment training is conducted to exercise the crew and ground personnel on the processes and procedures supporting the payload complement; support systems/activities, space station systems; and, in some cases, space shuttle systems. From a payload perspective, the objective of this training will be to provide a simulation environment in which the payload community can incorporate interfaces with the MCC-H into the environment already mastered in Integrated Payload Complement Training. The addition of these new interfaces will increase

the fidelity of the exercises and provide more realistic feedback and operational scenarios for the payload community.

Joint Multi-Segment Training for the payload community will involve the station crew, station MCC-H, POIC cadre, U.S. Users, and some Partner GSP. The shuttle crew, shuttle MCC-H, Partner Control Centers, and a complete set of Partner Users can also be incorporated into these simulations. Data, commanding, video, and voice interfaces will be extended to the payload community and Partners in a manner similar to the "real world" environment. The MSFC Simulation Director, MSFC Simulation Supervisor, and Simulation Engineers will coordinate the payload training objectives, scenarios, and activities for these simulations with the JSC Simulation Supervisor. Partner training organizations will coordinate payload issues with the MSFC Simulation Director/Supervisor. The JSC Simulation Supervisor will be responsible for the overall planning and execution of this training. (Note that there is an additional type of Joint Integrated training, Combined Shuttle Joint Integrated Training, which will not involve payload GSP or Partners.)

4.3 SIMULATOR COMPONENT FIDELITY/RESPONSIBILITY

Tables 4-II and 4-III provide a listing of all *Payload Acronym* simulator components provided by the PD and the SSTF/PTC, respectively. These tables also include the class of the simulator components and the required quantities. Definition of the simulator classes and component fidelities can be found in Appendix B of this document. Table 4-II designates the crew launch minus (CL-) delivery dates for PD-provided simulator components to the SSTF/PTC. The components listed in Table 4-III are required for the *Payload Acronym* simulator integration into the SSTF/PTC.

Provide components in Table 4-II that match the MANDATORY requirements in Section 5 of the PUDG and indicate which NEGOTIABLE requirements will or will not be met.

TABLE 4-II *PAYLOAD ACRONYM*-PROVIDED SIMULATOR COMPONENTS

SIMULATOR COMPONENT	QTY	FIDELITY	L- DELIVERY DATE

TABLE 4-III SSTF/PTC-PROVIDED SIMULATOR COMPONENTS

SIMULATOR COMPONENT	QTY
U.S. Lab Module	1
Payload Simulator Staging Area	1
Payload Executive Software	
Payload Acronym Payload Specific Data Files	
Payload Acronym Application Software	

4.4 SIMULATOR ARCHITECTURE AND INTERFACES

Figure 4-1 provides a block diagram of the *Payload Acronym* simulator configuration depicting all major simulator components, interfaces, and environments. The *Payload Acronym* simulator will interface with various SSTF/PTC resources and exchange information with various SSTF core systems simulators. Detailed requirements for the *Payload Acronym* simulator components shown in Figure 4-1 are provided in Sections 5 through 8 of this document.

Table 4-IV provides a checklist of the SSTF/PTC resources and core systems simulators with which the *Payload Acronym* simulator interfaces. Descriptions of the SSTF/PTC resources are provided in Sections 4.12 - 4.14 and 30.3.2 of the PUDG. Descriptions of the SSTF core system simulators are provided in Section 4.5 of the PUDG. Further discussion of how the interfaces specified in Table 4-IV interact with the *Payload Acronym* simulator is provided in Section 5 of this document.

If the simulator requires intrarack interfaces (power or data) to another simulator or system, it should be noted here and the responsible parties identified.

4.5 HARDWARE LOGISTICS

The PD will be responsible for verifying that the PD-provided simulator components listed in Table 4-II are in good working order and meet the requirements specified in this PSRD before shipping. The PD will be responsible for shipping the components as specified in Section 3.1.5 of the PUDG. The required delivery dates for the PD-provided simulator components are specified in Table 4-II. All simulator components which are listed are "hand-carried" will be delivered to the SSTF/PTC at least 24 hours prior to the training sessions.

Provide notice of deviation from Section 3.1.2 of the PUDG if the simulator is not being delivered as a complete rack, since the SSTF/PTC has only agreed to interface racks. State who/how the simulator is to be integrated into a rack. Also provide any deviations required for the Payload Acronym simulator from the logistics and handling procedures specified in Section 10.5 of the PUDG.

The configuration and installation of the *Payload Acronym* simulator components will be as detailed in Section 3.1.7 of the PUDG. Any payload specific installation instructions will be included in Section 4 of PSRD Volume II.

Maintenance, sustaining engineering, and post training support of the *Payload Acronym* simulator will be performed by the PD as detailed in Sections 3.1.8 through 3.1.10 of the PUDG. Any other specific maintenance requirements for the *Payload Acronym* simulator will be specified in Section 6 of PSRD Volume II.

Once the training requirements for the *Payload Acronym* simulator have been fulfilled, packing and shipping of the simulator will be performed by the PD as detailed in Sections 3.1.11 and 3.1.12 of the PUDG. *Provide information on any other specific post-training requirements here.*

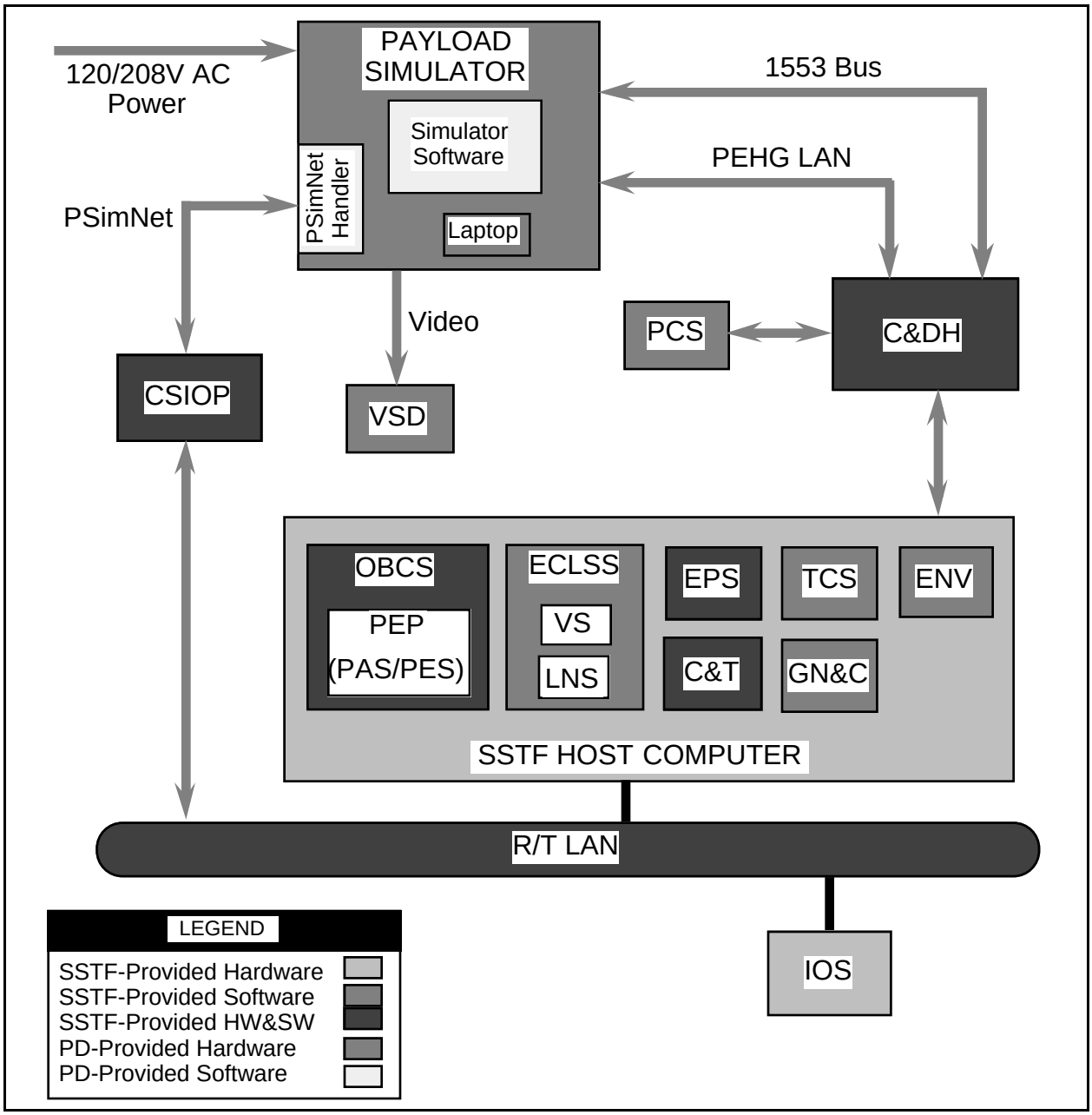

FIGURE 4-1 PAYLOAD ACRONYM SIMULATOR BLOCK DIAGRAM

TABLE 4-IV CHECKLIST OF SSTF/PTC INTERFACES

RESOURCES	REQUIRED
Payload Ethernet LAN and Payload Ethernet Hub Gateway (PEHG)	*YES/NO response*
Mil-Std-1553B Bus	*YES/NO response*
Payload Simulator Network (PSimNet)	*YES/NO response*
Portable Computer System (PCS)	*YES/NO response*
Signal Conversion Equipment (SCE)	*YES/NO response*
Instructor/Operator Station (IOS)	*YES/NO response*
Video Switching and Distribution (VSD) Subsystem	*YES/NO response*
Electrical Power	*YES/NO response*
CORE SYSTEM SIMULATORS	REQUIRED
Onboard Computer System (OBCS) Simulator	*YES/NO response*
Communications and Tracking (C&T) Simulator	*YES/NO response*
Environmental Control and Life Support System (ECLSS) Simulator - Cabin Air Temperature Simulator - Lab Nitrogen System (LNS) simulator - Vacuum System (VS) Simulator	 *YES/NO response* *YES/NO response* *YES/NO response*
Electrical Power System (EPS) Simulator	*YES/NO response*
Guidance, Navigation, and Control (GN&C) Simulator	*YES/NO response*
Thermal Control System (TCS) Simulator	*YES/NO response*
Environment (ENV) Simulator	*YES/NO response*

(This Page Intentionally Blank)

SECTION 5, *PAYLOAD ACRONYM* SIMULATOR INTERFACES TO THE SSTF/PTC

This section addresses the *Payload Acronym* simulator's physical, electrical, and data interfaces with SSTF/PTC resources, as well as the simulated interfaces to the SSTF core systems simulators in the SSTF/PTC. Also addressed are the *Payload Acronym* simulator's inputs to the Payload Resource Utilization (PRU) models in the SSTF.

5.1 INTERFACES TO SSTF/PTC RESOURCES

The *Payload Acronym* simulator will receive support from various SSTF/PTC resources, as previously listed in Table 4-IV. For each SSTF/PTC resource with which the *Payload Acronym* simulator interfaces, the following sections provide a description of the resource and a description of the *Payload Acronym* simulator's specific requirements. These interfaces will comply with the SSTF-to-payload simulator interface specifications given in Appendix III of the PUDG. *If there are additional resource requirements for the simulator include them here.*

For each of the following sections that is applicable to your simulator, keep the description provided and add section(s) giving details about the specific needs of your simulator; e.g., how many parameters or how fast is the data transfer rate, what displays or commands are used, etc.

5.1.1 Payload Ethernet LAN and Payload Ethernet Hub Gateway (PEHG)

The Ethernet connection provides the means for the *Payload Acronym* simulator to get its mid-rate data into the simulation data stream. The data contained on this data line will replicate the data that is shipped into the flight Command and Data Handling (C&DH) system via the ISPR Ethernet connection. The electrical interface specifications for the PEHG are provided in Section 30.4.4.2.2.2 of the PUDG.

5.1.2 Mil-Std-1553B Bus

The 1553 connection provides the means for the *Payload Acronym* simulator to get its low rate housekeeping data into the simulation data stream. The data contained on this data line will replicate the data that is shipped into the flight C&DH system via the ISPR 1553 interface. The electrical interface specifications for the 1553 bus are provided in Section 30.4.4.2.2.2 of the PUDG.

5.1.3 Payload Simulator Network (PSimNet)

The *Payload Acronym* simulator will interface with the SSTF/PTC for simulation unique control and data through the PSimNet Ethernet connection. This interface will provide the *Payload Acronym* simulator with all of its simulation control functions. These control functions include the commands required to initialize, control, and insert malfunctions into the *Payload Acronym* simulator as detailed in section 6 of this document. The PSimNet will also

provide an interface between the simulator and the SSTF core systems simulators as detailed in section 5.2 of this document. The interface protocols for the PSimNet are provided in Section 30.3.3.6 of the PUDG, and the electrical interface specifications are provided in Section 30.4.4.2.2.2 of the PUDG.

5.1.4 Portable Computer System (PCS)

The PCS is used to provide payload data and commanding capabilities from positions in the Lab other than the payload front panel or dedicated laptop computer. This computer is tied into the C&DH system via a 1553 interface or the PEHG LAN. The PCS will be loaded with the appropriate NASA-provided flight software for each increment.

5.1.5 Signal Conversion Equipment (SCE)

The SCE provides for I/O interfaces between the hardware signals from the payload simulator hardware and the SSTF/PTC host system. Data types handled by the SCE include discrete inputs, discrete outputs, analog inputs, and analog outputs. The SCE physical interfaces are defined in Section 30.4.4.2.1 of the PUDG. The *Payload Acronym* simulator has the following signals that require the SCE interface*: list specific signals here and provide interface requirements.*

5.1.6 Instructor/Operator Station (IOS)

The IOS provides a means for controlling the *Payload Acronym* simulator from a remote location while also controlling and monitoring the other payload and systems simulators. The IOS communicates with the *Payload Acronym* simulator via the PSimNet for receiving data from and sending commands to the *Payload Acronym* simulator.

5.1.7 Video Switching and Distribution (VSD) Subsystem

The VSD subsystem provides capabilities for routing video signals between the *Payload Acronym* simulator and other training facilities. Connectors for NTSC composite RS-170 video are available at each rack interface. Video generated by the *Payload Acronym* simulator can be viewed in the SSTF at an IOS or on monitors in the briefing/debriefing rooms. Video can also be routed to other locations, including MCC-H and the HOSC/POIC. *Include specifics on the video output from the Payload Acronym simulator.*

5.1.8 Electrical Power

The SSTF/PTC facility provides electrical power and ground to each rack location. One five-wire connector (NEMA L21-30) will supply 120/208 VAC 3-phase power at 30 amps. The electrical power connection specifications are defined in Section 30.4.4.1 of the PUDG. *Include specifics on the electrical power required by the Payload Acronym simulator. Also include any special requirements for power/phase/etc.*

5.2 INTERFACES TO CORE SYSTEMS SIMULATORS

This section addresses the interfaces between the *Payload Acronym* simulator and the SSTF core system simulators. These core system simulators provide support to the payload simulators as well as training tools for ISS ground controllers on ISS subsystems, and are described in Section 4.5 of the PUDG. The *payload acronym* simulator controller will provide data to the core system simulators regardless of the power status of the simulator. For example, if a hot furnace is inadvertently turned off, heat will continue to be dumped into the cooling loops until the furnace reaches ambient temperature. *(Examples here should be made specific for the particular payload.)*

The *payload acronym* simulator is responsible for updating the data provided to the core system simulators at a 1 Hz rate over the PSimNet. These interfaces will comply with the payload training simulator to SSTF core system interface specifications given in Section 30.3.3.1 of the PUDG. Core system interface requirements are provided to the SSTF/PTC in the Payload Simulator Interface Definition (PSID) forms. The PSID forms containing the requirements for the *Payload Acronym* simulator are included in Appendix D of this document.

The following sections provide the details of the interfaces between the *Payload Acronym* simulator and each core system simulator.

5.2.1 Onboard Computer System (OBCS) Simulator

The OBCS simulator consists of a combination of hardware and software components that provide a full system signature simulation of the ISS onboard C&DH system and its interface components. The OBCS supports ISS systems command and control, supports ISS payload users, and provides the services for flight crew and ground operations. The OBCS simulates the Multiplexer/Demultiplexer (MDM) which provides data processing and transfer for the *Payload Acronym* simulator data. Since the OBCS includes the actual Flight Software (FSW), the data processing capabilities will duplicate those available on-orbit. *Include specifics on the OBCS interfaces to the Payload Acronym simulator.*

5.2.2 Communications and Tracking (C&T) Simulator

The C&T simulator provides the AOS/LOS status for both the S-band and Ku-band. C&T supports all uplink and downlink capabilities with the exception of High Rate Data Link capabilities. *Include specifics on the C&T interfaces to the Payload Acronym simulator.*

5.2.3 Environmental Control and Life Support System (ECLSS) Simulator

The ECLSS simulator provides a software simulation of the atmosphere of the U.S. Lab, the LNS, and the VS. The cabin air temperature model includes the simulation of cooling air and heat loading at each ISPR location. ECLSS will provide the *payload acronym* simulator with the cabin temperature in degrees Fahrenheit. The *payload acronym* simulator will provide ECLSS with the amount of heat being dumped to cabin air in BTUs per second.

The LNS simulator is a hardware and software simulation of the nitrogen system to the ISPRs. The hardware simulation consists of dummy N2 lines and connectors for the *Payload Acronym* simulator, including both the LNS main line and the LNS standoff lines. The LNS

software model will simulate the gaseous nitrogen flow rate to any ISPR location in the U.S. Lab module. As part of this simulation, LNS will provide the *payload acronym* simulator with the nitrogen pressure available in psi. The *Payload Acronym* simulator will provide LNS with the amount of nitrogen used in pounds per second.

The VS simulator is a hardware and software simulation of the Vacuum Exhaust System (VES) and Vacuum Resource System (VRS) valves and sensors, the manual valve, and motor operated valve manual override capability. VS software simulates normal operations, safeguard operations, maintenance, and shutdown modes dynamically. The VS simulator reports the current VES and VRS simulated vacuum pressures at each ISPR location to *Payload Acronym* simulator in psi. The *Payload Acronym* simulator reports the rate of gas exhausted to the VES and VRS from the payload as a flow rate measured in pounds per second.

5.2.4 Electrical Power System (EPS) Simulator

The EPS simulator provides a power status to the *Payload Acronym* simulator for both the main bus power and the essential bus power available to the rack. This simulation includes the emulation of the on-board utility outlet panels and a simulation of the power available to the payload. The EPS simulator reports the current voltage available on the main and essential buses in volts DC. The *Payload acronym* simulator will supply the EPS simulator with the realtime power load on the main and essential buses in watts. Since the real electrical power supplied to the simulator is not interactive with the power status provided by the EPS, the *Payload Acronym* simulator will have to make the payload appear interactive based on the power status received from EPS. *Include specifics on the simulated electrical interfaces to the Payload Acronym simulator.*

5.2.5 Guidance, Navigation, and Control (GN&C) Simulator

The GN&C simulator models the flight GN&C system, providing the generation of state vectors, attitude, and pointing support data. *Include specifics on the GN&C data required by the Payload Acronym simulator.*

5.2.6 Thermal Control System (TCS) Simulator

The TCS simulator is a hardware and software simulation of the thermal control functions onboard Space Station. The hardware simulation consists of dummy coolant lines and connectors that will mate with the *Payload Acronym* simulator. The Internal Active Thermal Control System (IATCS) simulates the nominal and faulted operation of the Moderate Temperature and Low Temperature payload Rack Flow Control Assemblies (RFCA). Coolant supply and return line temperature and flow rates are simulated dynamically. The rates are affected by RFCA coolant outlet temperatures and flow rates. The rest of the flight IATCS loop hardware System Flow Control Assembly, Loop Crossover Assembly (LCA) and pump is simulated statistically based on IATCS system state changes of startup, normal operations, and shutdown. TCS will provide the flow rates in pounds per second and temperatures in degrees Fahrenheit for the moderate and low temperature cooling loops to the *payload acronym* simulator. The *Payload acronym* simulator will provide the TCS simulation with the heat load, in BTUs per second, currently being added into each of the cooling loops.

5.2.7 Environment (ENV) Simulator

The ENV simulator provides a software simulation of the ISS on-orbit environment. This simulation includes effects of gravity, South Atlantic anomaly, solar sunrise/sunset and magnetic fields. *Include specifics on the ENV data required by the Payload Acronym simulator.*

5.3 *PAYLOAD ACRONYM* DATA FOR PRU MODELS

For systems training when the *Payload Acronym* simulator is not being used, the SSTF/PTC has the capability to use PRU mini software models to provide a minimum set of state and consumption data to simulate the load that *Payload Acronym* would place on the systems models. PRU models are described in Section 4.9 of the PUDG, and the PRU Form that is used to collect the information needed to develop the models is provided in Section 30.5.2 of the PUDG.

Table 5-I provides the values for the *Payload Acronym* PRU model. The first column gives the load placed on the various core systems, if any, when the payload is in an off state. The second column indicates the load on the various systems when the payload is powered, but no actual payload processing is being conducted. The third column indicates the load placed on Space Station systems when the payload is operating in a full up condition.

TABLE 5-I *PAYLOAD ACRONYM* PRU MODEL INPUTS

CORE SYSTEM MODEL		OFF	STANDBY	ON
EPS:	Main Bus (amps)	*X.X*	*X.X*	*X.X*
	Essential (amps)	*X.X*	*X.X*	*X.X*
TCS:	Moderate Temp. Loop (BTU/sec)	*X.X*	*X.X*	*X.X*
	Low Temp. Loop (BTU/sec)	*X.X*	*X.X*	*X.X*
ECLSS:	Heat to Cabin Air (BTU/sec)	*X.X*	*X.X*	*X.X*
	Nitrogen Usage (lb./sec)	*X.X*	*X.X*	*X.X*
	Waste Gas (lb./sec)	*X.X*	*X.X*	*X.X*
	Vacuum Resource (lb./sec)	*X.X*	*X.X*	*X.X*

(This Page Intentionally Blank)

SECTION 6, *PAYLOAD ACRONYM* SIMULATOR SOFTWARE REQUIREMENTS

This section specifies the software capabilities required for the *Payload Acronym* simulator to operate within the SSTF/PTC simulation environment. The *Payload Acronym* simulator will have PD-provided software that simulates all major aspects of the flight payload processor, and also provides simulation-unique functions. The *Payload Acronym* simulator software will reside on the PD-provided (*IBM 486, Silicon Graphics, Macintosh, Etc.*) processor and will provide a flight-like representation of the operations and interfaces of the *Payload Acronym* payload. The software will provide flight-like interfaces to the crew and ground controllers by responding to crew actions and providing data parameters to the C&DH via the 1553 bus and the PEHG. The software will also support simulated uplink commands by accepting the command inputs from the SSTF executive processor via the 1553 interface and modifying the payload processing parameters appropriately.

The *Payload Acronym* simulator will interface with the SSTF/PTC simulation system through the PSimNet to perform initialization, mode control, and malfunction insertion. The interface specifications for the PSimNet communications are provided in Section 30.4 of the PUDG. The following specific types of messages are discussed in the PUDG:

- Establish connection messages
- Simulation control messages
- Station data messages
- PTS data messages
- Malfunction messages
- Poke messages
- Panel switch override and Panel switch verification messages *(if implemented by the Payload Acronym simulator)*
- Error messages
- Ping messages

6.1 OPERATING MODES

The *Payload Acronym* simulator will be capable of receiving mode control messages from the IOS via the PSimNet. The formats for these messages are specified in the Section 30.4.2.3.3 of the PUDG. The *Payload Acronym* simulator software will respond to messages to operate in the following different modes: Freeze, Initialize, Datastore, Run, Hold, and Terminate. The inter-relationships of these modes is illustrated in Figure 6-1.

6.1.1 Freeze Mode

Freeze serves as a “standby” mode for the simulator when waiting for another mode command. Some other modes can only be commanded from the Freeze mode, and will return to Freeze mode after completion. In this mode the simulation exercise is frozen in time and

simulation values for consumables and state variables are held constant. Note that communications between the *Payload Acronym* simulator software and the SSTF/PTC system continues during the Freeze mode.

6.1.2 Initialize Mode

Initialize is sometimes referred to as Return-to-Datastore. When commanded to this mode the *Payload Acronym* simulator will initialize itself to the state determined by the selected Initial Conditions (IC) point; if the IC point is zero the simulator will initialize into its power off state. The simulator will automatically transition to the Freeze mode upon completing Initialization.

6.1.3 Datastore Mode

When commanded into the Datastore mode, the *Payload Acronym* simulator will create an IC point (also called a Datastore point) representing the state of the payload simulator at that point in time. The *Payload Acronym* simulator shall be capable of storing data for several IC points. The Datastore mode can only be commanded from the Freeze mode, and the simulator will return to the Freeze mode upon completing the Datastore.

The simulator will be configured with TBD data stores prior to being shipped from the PD site. These data stores are built into the simulator by the PD to provide logical starting points for training activities. Table 6-I defines the PD-built data stores for the *Payload Acronym* simulator.

These data store points will have to be selected via the TST process so that they are useful for training purposes. If 'payload mode control' is deemed sufficient for controlling the simulator, no PD-provided data stores will be required.

TABLE 6-I *PAYLOAD ACRONYM* PD-PROVIDED DATA STORES

DATA STORE LABEL	DATA STORE DESCRIPTION

6.1.4 Run Mode

Run is the normal operating mode of the *Payload Acronym* simulator. In this mode simulation events are progressing in realtime; the simulator software will respond to command inputs, update values for consumables and state variables, and generate outputs in a flight-like manner.

Every 15 minutes (default time) while in the Run mode, the *Payload Acronym* simulator will automatically create a Safestore point by recording and saving the time dependent

data. The simulator will be capable of retaining the last four Safestore points during a training session, to be available if the session terminates abnormally. The Safestore need not be saved after a session terminated normally. When a Return-to-Safestore command is received, the *Payload Acronym* simulator will re-initialize or otherwise reconfigure itself into the state recorded in the specified Safestore.

6.1.5 Hold Mode

Hold is a mode of the SSTF/PTC during which the training session has temporarily suspended realtime execution, and communications between the SSTF/PTC and the *Payload Acronym* simulator are suspended for an indefinite period of time. When commanded into Hold, the *Payload Acronym* simulator should enter a suspended state and wait for communications to resume, normally with another moding command.

6.1.6 Terminate Mode

Terminate mode is used to bring the *Payload Acronym* simulator to an orderly shutdown at the completion of a training session.

6.2 MALFUNCTION CAPABILITIES

The *Payload Acronym* simulator software will support malfunction operations to the extent determined by the TST. Control for these malfunctions will be initiated at the IOS and input to the simulator software via messages through the PSimNet. The specifications for these malfunction messages are provided in Section 30.4.2.3.6 of the PUDG. The simulator software responds to the malfunction messages by modifying its data processing so that the data output indicates the existence of the malfunction. The malfunction will be reset by either the performance of the proper malfunction procedures or by a reset message from the IOS. The malfunctions that will be simulated by the *Payload Acronym* simulator are given in Table 6-II.

Malfunction requirements are provided to the SSTF/PTC in the PSID forms so that the required messages can be generated. The PSID forms containing the requirements for the *Payload Acronym* simulator are included in Appendix D of this document.

Several paragraphs should be added here to explain the malfunctions, as required.

TABLE 6-II *PAYLOAD ACRONYM* SIMULATOR MALFUNCTIONS

DESCRIPTION/SIGNATURE	MALF ID	TYPE	VALUES

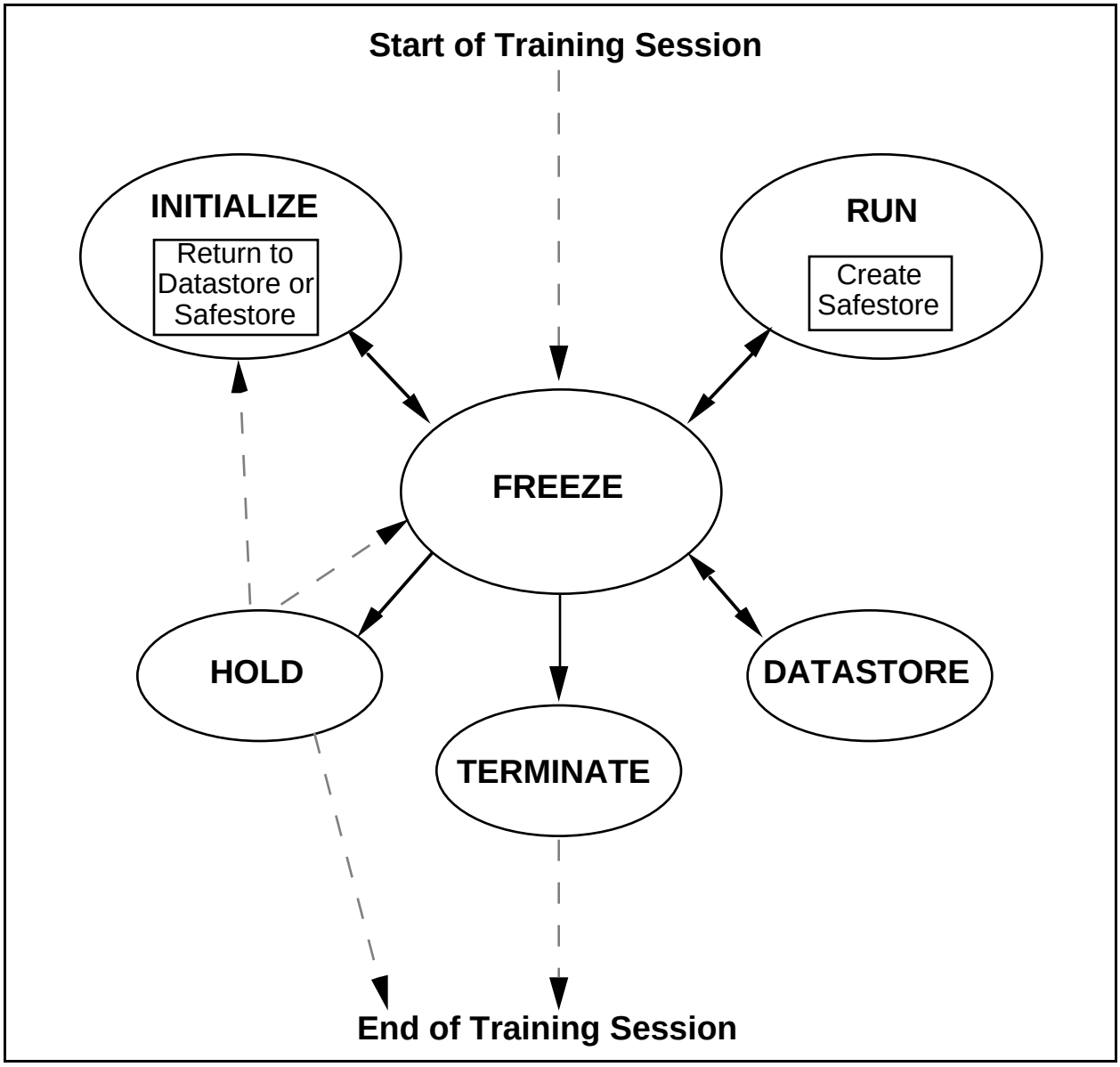

FIGURE 6-1 *PAYLOAD ACRONYM* STATE DIAGRAM

6.3 IOS DISPLAY REQUIREMENTS

In order to monitor internal operations of the *Payload Acronym* simulator during a training session the software will output data through the PSimNet to be viewed on the IOS. Note that these are parameters that are not normally output by the simulator but are useful for keeping track of the status of the simulator. These parameters will be defined on PSID forms included in Appendix D of this document, where they will be defined as "lookable". A listing of these parameters, with a description of each, is provided in Table 6-III.

TABLE 6-III *PAYLOAD ACRONYM* IOS DISPLAY REQUIREMENTS

PARAMETER DESCRIPTION	DIS TERM	RANGE OF VALUES

6.4 *MISCELLANEOUS* INTERFACE REQUIREMENTS

This section should be used to specify any other interface requirements between the simulator and the SSTF/PTC system that happen over the PSimNet. This can include poke messages, pings, error messages, etc.

(This Page Intentionally Blank)

SECTION 7, SIMULATOR HARDWARE MOCKUP REQUIREMENTS

This section identifies payload-unique hardware required at the SSTF/PTC to support training activities. The *Payload Acronym* simulator hardware components were summarized in Tables 4-II. These components and their interfaces with the crew and U.S. Lab module mockup will be discussed separately in the following sections. Figure 3-1 shows the overall layout of the *Payload Acronym* hardware as it will be mounted in the rack.

7.1 RACK FRONT PANELS

The rack components provided by the PD will include *insert list of panels/modules*. These hardware components will provide a *total fidelity training* environment for the crew in which all Light Emitting Diodes (LEDs), switches, dials, and displays operate in a flight like manner.

7.1.1 First Element

Provide a complete description of this element including its class level (fidelity). The description should include all control and monitoring areas with their associated displays and switches, and any doors/removable panels that the crew interfaces with during nominal or contingency operations. Descriptions of the hardware located behind any removable panels should also be discussed. For example, if a door covers a payload centrifuge, a brief description of the centrifuge should be included. The "first panel" Panel is illustrated in Figure 7-1.

7.1.2 Second Element

Provide a complete description of this element including its class level (fidelity). The description should include all control and monitoring areas with their associated displays and switches, and any doors/removable panels that the crew interfaces with during nominal or contingency operations. Descriptions of the hardware located behind any removable panels should also be discussed. For example, if a door covers a payload centrifuge, a brief description of the centrifuge should be included. The "second panel" Panel is illustrated in Figure 7-2.

Add a similar section for each of the simulator front panels

7.2 *PAYLOAD ACRONYM* STOWAGE ITEMS

The *Payload Acronym* payload will have several items stowed in rack stowage lockers. These items include *provide a list of stowage items here or provide a table if a lot of items exist.* Each of these items is discussed separately in the following sections.

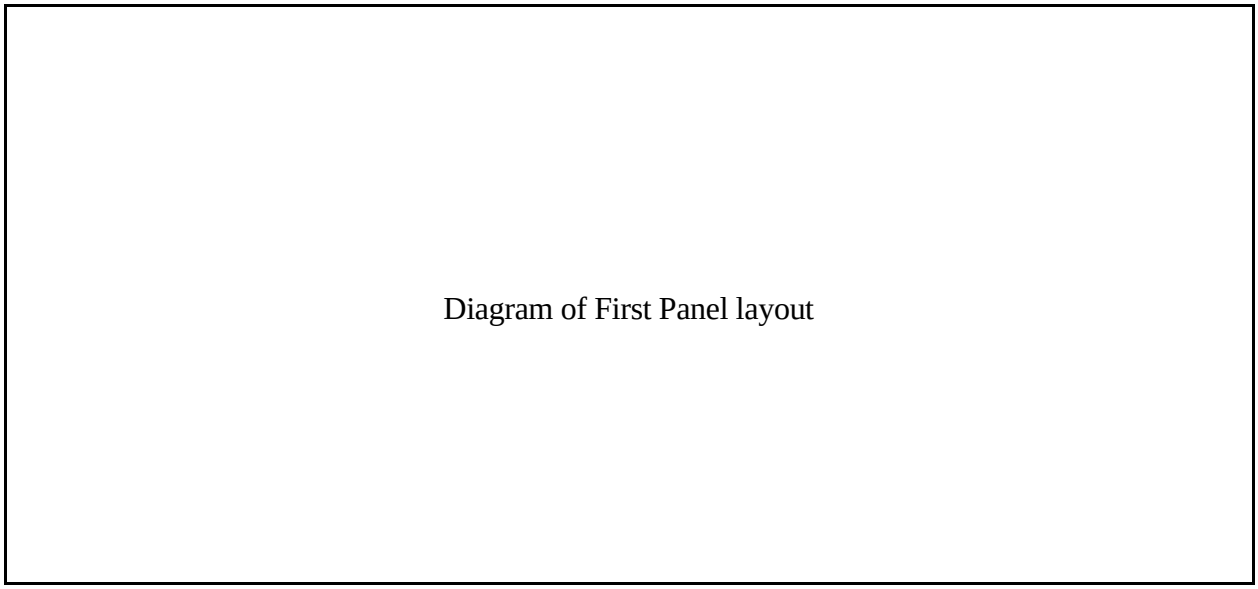

FIGURE 7-1 *PAYLOAD ACRONYM FIRST PANEL* LAYOUT

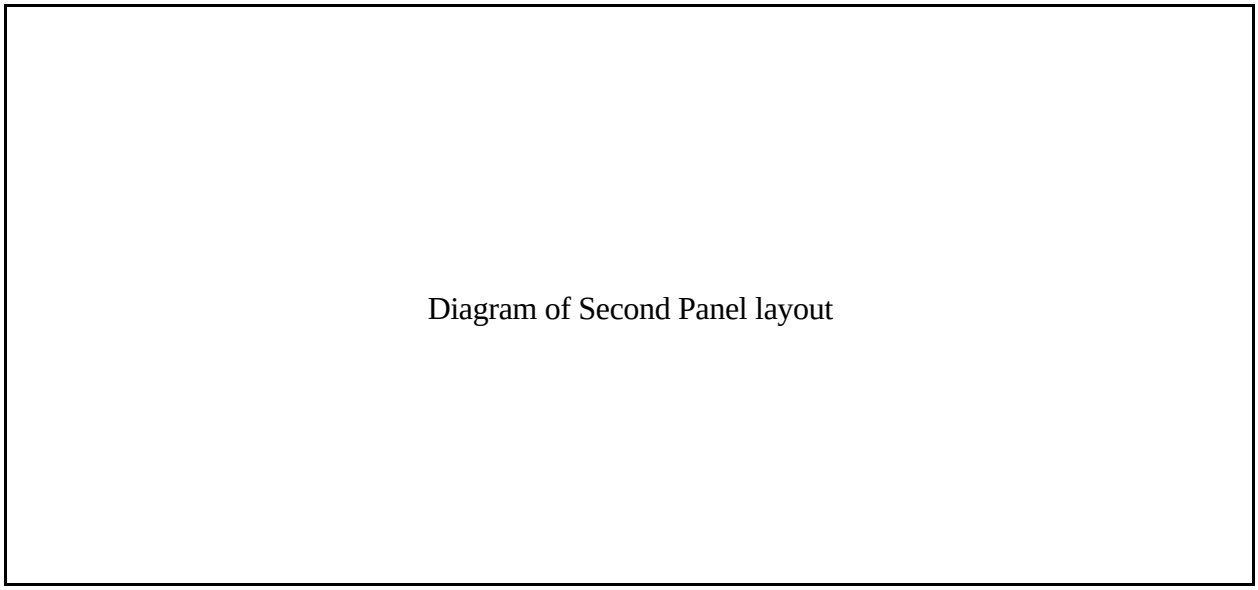

FIGURE 7-2 *PAYLOAD ACRONYM SECOND PANEL* LAYOUT

7.2.1 Stowage Item One

For each stowage item, give a description, a quantity, a class level, and stowage location (if known).

7.2.2 Stowage Item Two

For each stowage item, give a description, a quantity, a class level, and stowage location (if known).

NOTE: Sections 7.2 and 7.3 may be changed to a listing of the stowage items and a reference to a flight stowage document if such a document is available in time to support training.

7.3 *PAYLOAD ACRONYM* STOWAGE CONTAINERS

This section provides a description of all the stowage containers required by the *Payload Acronym* payload. This information is based on a preliminary stowage plan and will be superseded by the flight stowage plan when baselined. All stowage containers required for the *Payload Acronym* payload simulator, along with the associated foam, will be provided by the PD.

A subsection should be included for each type of stowage container, although several containers of the same type can be included in any given subsection. The descriptions should include container type and its fidelity. The stowage location should be given for each separate container mentioned. Descriptions of the items stowed in these trays is given in Section 7.2.

7.4 *PAYLOAD ACRONYM* SIMULATOR INTERFACE CABLES

The SSTF/PTC will provide interface cables between the ISPR-mounted Interface Panel (IIP), which is a simulator unique panel, and the Standoff-mounted Interface Panel (SIP), which corresponds to the Utility Interface Panel (UIP) in the real Lab. If a simulator payload rack does not include an IIP, the PD will provide the interface cables between the simulator and the SIP. Section 30.4.3.2 of the PUDG provides information about the physical interfaces, in particular descriptions of the IIP and the SIP.

The PD will provide interface cables to connect the *Payload Acronym* simulator hardware to the IIP or SIP connectors for the 1553 bus, the PEHG, the PSimNet, etc. A description and the pin out specifications for each of these cables is given in Appendix D, and will comply with the specifications provided in Section 30.4.3.2.4 of the PUDG. The PD will also be responsible for providing the required cables to connect the components of the *Payload Acronym* simulator.

Specify any special power/phase/etc., requirements for the Payload Acronym simulator here and describe the necessary cable to provide the special interface.

7.5 *PAYLOAD ACRONYM* SIMULATOR HAZARDS

This section provides a discussion of the safety hazards associated with components of the *Payload Acronym* simulator. *Provide a list of all components and the safety hazards associated with each; these should include hazards associated with sight, hearing, lifting, falling, dropping, getting hit, etc.*

SECTION 8, *PAYLOAD ACRONYM* FLIGHT SOFTWARE UTILIZATION REQUIREMENTS

The purpose of this section is to define the simulated Payload Executive Processor (PEP) Software (PES) command, control, and monitoring functions that are used by the *Payload Acronym* simulator. This communication occurs over the 1553 bus. Commands will be accepted by a SSTF/PTC-provided PEP and passed on to the *Payload Acronym* simulator processor for processing. The commands are used to *list basic command functions*. *Payload Acronym* data will be output by the *Payload Acronym* simulator into the PEP for onboard monitoring and downlink. This data will provide information on *list content of data stream. This section may contain a reference to the facilities' PDL C&DH Data Set, depending on when the PSRD is delivered. PDs will have to submit this data by L-19 to support the training schedule.*

The *Payload Acronym* simulator will output a health and status data stream containing the parameters defined in *the facilities' PDL C&DH Data Set.* Data transfer will be at the rate of *XX* packet(s) per second where each packet contains <*number of messages*> *XX*-word messages. A command rate of one command per second shall also be supported by the PEP-to-*Payload Acronym* simulator link. The *Payload Acronym* simulator processor will conform to standard ISS data protocol. *Provide information indicating the fidelity of the H&S data.*

All data parameters identified in the *PIP Annex 4 tables or PDL tables* , as well as the simulator parameters defined in Table 6-III and associated PSID forms, will be available for display at the IOS for monitoring *Payload Acronym* operations during a training session. DT personnel will be responsible for building these displays.

8.1 PEP SOFTWARE

The *Payload Acronym* payload simulator requires the use of a simulated PEP/PES. The PES will work in conjunction with the payload specific data files to perform processing on the *Payload Acronym* output data parameters and allow the transfer of commands for uplink/PCS commanding. The training version of the PES, which is a duplication of the flight load, will be provided by the SSTF/PTC and will run on the PTC PEP. After being processed by the PEP, data will be made available to the 1553 bus for shipment to the Command and Control MDM and the PCS.

The *Payload Acronym* simulator requires the use of payload specific data files that run in conjunction with the PES. These data files allow the simulator to take advantage of the PEP capabilities to display and monitor data. These files will be a duplication of the flight load, will run on the SSTF-provided PEP, and will provide the following processing functions. *Provide a list of the functions provided by the payload specific data files for Payload Acronym.*

8.2 PAYLOAD APPLICATION SOFTWARE

The *Payload Acronym* payload requires the use of Payload Application Software (PAS) to perform additional processing on its output data parameters. The training version of this software will be provided by the SSTF/PTC, and will be a duplication of the flight load. This software will run on the SSTF-provided *PEP/PCS* and will provide the following processing. *Provide a list of the functions provided by the PAS for Payload Acronym.*

8.3 PCS DISPLAYS

This section defines the onboard PCS displays that are utilized by the *Payload Acronym* payload. These displays provide the crew with a means to monitor the condition of the *Payload Acronym* payload and to input commands to the payload. *Describe any other uses of the PCS displays as appropriate for Payload Acronym.*

There is one PCS display dedicated to the *Payload Acronym* payload. This display (display name) is shown in Figure 8-1. *If a flight document exists that gives the variable data definition for each of the display fields, reference it here or otherwise provide the information.*

In addition to the dedicated PCS display, *Payload Acronym* also displays data on the *ABCD* display page. The *ABCD* display is shown in Figure 8-2. *If a flight document exists that gives the variable data definition for each of the display fields, reference it here or otherwise provide the information.*

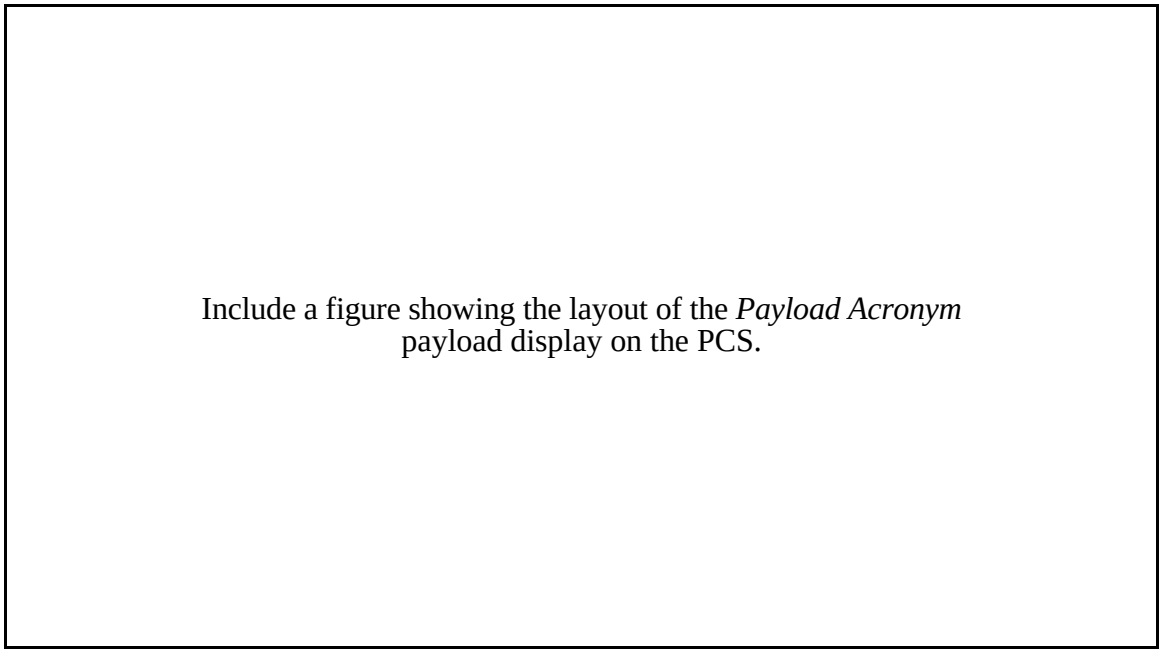

FIGURE 8-1 *PAYLOAD ACRONYM* PCS DISPLAY

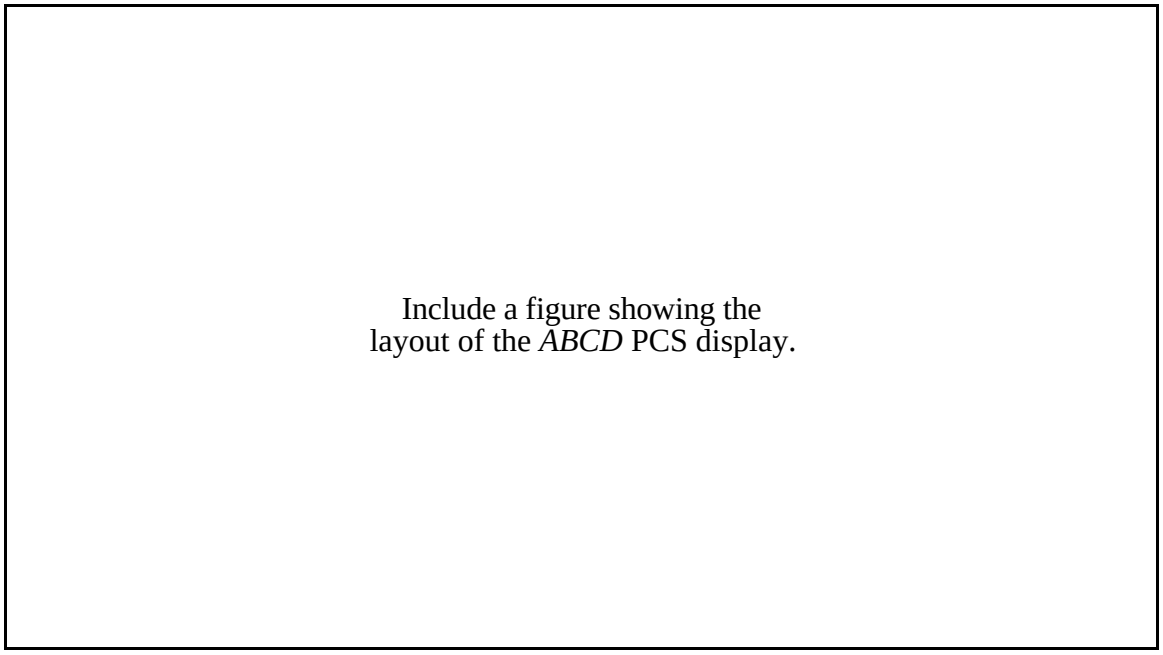

FIGURE 8-2 ABCD PCS DISPLAY

(This Page Intentionally Blank)

SECTION 9, SIMULATOR DEVELOPMENT AND VERIFICATION PROCESS

The payload simulator development and verification process is described in the following sections. This process is derived from All-Flights Payload Integrated Training Plan, D683-43033, *Month Year*. The PD will support this cycle for development and verification of a payload simulator to be used at the SSTF/PTC for training on his or her payload element.

9.1 PAYLOAD SIMULATOR REQUIREMENTS REVIEW (PSRR)

A Volume I PSRR will be held two to four weeks after the PSRD Volume I is delivered. This review, a telecon or videocon, is chaired by the PTIM with participation required by the *Payload Acronym* SE and PTC personnel. It is recommended that the assigned DT instructor(s) and the *Payload Acronym* PD also participate. The purpose of the review is to ensure that all involved parties understand the requirements in the PSRD Volume I and are prepared to implement them.

A Volume II PSRR will be held two to four weeks after the Volume II is delivered. The format and participation of this review is the same as for the Volume I PSRR. The purpose of this review is to ensure that all involved parties understand the checkout procedures and the maintenance requirements in the PSRD Volume II and are prepared to implement them.

9.2 PAYLOAD SIMULATOR INVENTORY AND INTERFACE CHECKOUT (PSIIC)

A PSIIC will be performed at the SSTF/PTC soon after the simulator is received. The inventory list and checkout procedures in the PSRD Volume II are used during this checkout. This event is performed by PTC personnel, with participation required by the *Payload Acronym* PD and SE. The objectives of the PSIIC are to verify that no damage occurred to the simulator during shipment, that all simulator components expected were received, and to verify that simulator interfaces to the PTC are operational.

Integration of the simulator into the PTC will be performed as defined in PSRD Volume II. Upon completion of simulator integration, a Simulator Acceptance Test (SAT) will be conducted by PTC personnel to verify the simulator integration, system interfaces, and readiness for the Payload Simulator Acceptance Test (PSAT). This test should be performed utilizing procedures written by PTC personnel.

9.3 PAYLOAD SIMULATOR ACCEPTANCE TEST (PSAT)

A PSAT will be performed using the Payload Simulator Test Procedures (PSTP) written by the *Payload Acronym* SE. The PSAT will be conducted by the *Payload Acronym* SE with participation required by PTC personnel and the *Payload Acronym* PD. DT instructors and the PTIM are encouraged to attend. The objective of the PSAT is to verify that the integrated simulator meets the requirements defined in the PSRD Volume I. Examples of items to be tested are IOS interfaces, moding, limit sensing, data validity, PCS interfaces, interfaces to other models, and malfunctions.

9.4 PAYLOAD SIMULATOR TRAINING ACCEPTANCE TEST (PSTAT)

A Payload Simulator Training Acceptance Test (PSTAT) will be performed to verify that the simulator and all support materials are ready for use in training. This event is chaired by the PTIM, with required attendance of the *Payload Acronym* SE, DT instructors, and Payload Crew representative. PTC personnel are required to support this event, and the *Payload Acronym PD* is encouraged to attend. This event, using the Payload Training Lesson Plan (PTLP) and crew procedures, will be a dry run of the Payload Crew classroom and hands-on training sessions and must be completed prior to *Payload Acronym* crew training at the SSTF/PTC.

9.5 PAYLOAD COMPLEMENT REQUIREMENTS TEST (PCRT)

A Payload Complement Requirements Test (PCRT) will be performed after the final FSW load is delivered to the PTC. This event is chaired by the PTIM, with required attendance of all the SEs and DT instructors. PTC personnel are required to support this event. This test will verify that the requirements in the Payload Complement Requirements Checklist (PCRC) are met, such that the integrated payload simulator complement reflects the actual increment complement of payloads and support equipment and that all interfaces to the PTC operate correctly in the integrated environment.

APPENDIX A

ABBREVIATIONS AND ACRONYMS

(This Page Intentionally Blank)

A, ABBREVIATIONS AND ACRONYMS

AOS	Acquisition Of Signal
C&DH	Command and Data Handling System
C&T	Communications and Tracking
DRR	Document Release Record
DT	Manned Systems Training Group
ECLSS	Environmental Control and Life Support System
ENV	Environment Simulator
EPS	Electrical Power System
EXPRESS	Expedite the Processing of Experiments to Space Station
FSW	Flight Software
GN&C	Guidance, Navigation, and Control
H&S	Health and Status
HOSC	Huntsville Operations Support Center
IATCS	Internal Active Thermal Control
IIP	ISPR-mounted Interface Panel
IOS	Instructor/Operator Station
ISPR	International Standard Payload Rack
ISS	International Space Station
ITP	Integrated Training Plan
JSC	Johnson Space Center
LCA	Loop Crossover Assembly
LED	Light Emitting Diode
LNS	Lab Nitrogen System
LOS	Loss Of Signal
MCC-H	Mission Control Center - Houston
MDM	Multiplexer/Demultiplexer
MSFC	Marshall Space Flight Center
NTSC	National Television Standards Committee
OBCS	Onboard Computer System
PAS	Payload Application Software
PCITP	Payload Complement Integrated Training Plan
PCRC	Payload Complement Requirements Checklist
PCRT	Payload Complement Requirements Test
PCS	Portable Computer System
PD	Payload Developer
PDC	Payload Development Center

ABBREVIATIONS AND ACRONYMS (CONTINUED)

PDL	Payload Data Library
PEHG	Payload Ethernet Hub Gateway
PEP	Payload Executive Processor
PES	Payload Experiment Software
POIC	Payload Operations Integration Center
PRU	Payload Resource Utilization
PSID	Payload Simulator Interface Definition
PSimNet	Payload Simulator Network
PSAT	Payload Simulator Acceptance Test
PSIIC	Payload Simulator Inventory and Interface Checkout
PSRD	Payload Simulator Requirements Document
PSRR	Payload Simulator Requirements Review
PSTAT	Payload Simulator Training Acceptance Test
PSTP	Payload Simulator Test Procedure
PTC	Payload Training Capability
PTR	Payload Training Integration Manager
PTIM	Payload Training Integration Manager
PTLP	Payload Training Lesson Plan
PUDG	Payload Users Development Guide (for the SSTF/PTC)
RFCA	Rack Flow Control Assembly
SAR	Simulator Acceptance Review
SAT	Simulator Acceptance Test
SCE	Signal Conversion Equipment
SE	Simulation Engineer
SIP	Standoff-mounted Interface Panel
SIR	Standard Interface Rack
SSTF	Space Station Training Facility
TBE	Teledyne Brown Engineering
TCS	Thermal Control System
TO	Training Objective
TST	Training Strategy Team
VES	Vacuum Exhaust System
VRS	Vacuum Resource System
VS	Vacuum System
VSD	Video Switching & Distribution Subsystem

APPENDIX B

SIMULATOR CLASS LEVELS

(This Page Intentionally Blank)

B, SIMULATOR CLASS LEVELS

The five simulator class levels are defined as follows:

Class 1: Flight Equivalent Hardware. This is flight like hardware which may or may not be flight certified. Typical Class 1 simulators would be a duplicate of the flight hardware that was procured for training purposes, backup flight hardware, or an engineering model.

Class 2: Class 2 simulators have flight like hardware panels with fully functional controls and displays. Functionality for these panels is provided by a PD-provided software models which read panel switches, drive panel displays/indicators, and provide data to the crew and downlink displays. Class 2 simulators are further sub-divided into Class 2A and 2B. Class 2A run PD-supplied software on the SSTF Host computer system (note that this mode is not currently supported in the SSTF/PTC); Class 2B simulators run their software on a PD-provided simulation machine.

Class 3: Class 3 simulators are stand alone systems with virtual panels that are driven by a software load resident on the machine. Class 3 simulators are further sub-divided into Class 3A and 3B. Class 3A run PD-supplied software on the SSTF Host computer system (note that this mode is not currently supported in the SSTF/PTC); Class 3B simulators run their software on a PD-provided simulation machine.

Class 4: Class 4 simulators consist of front panels that have the physical look and feel of the flight unit, but no operable hardware or software behind the panel to add functionality.

Class 5: Class 5 simulators consist of front panels that are a photograph or are drawn to look like the flight panel. They have no operational switches/displays or functional software.

Table B-I provides the definition of the training component fidelity. While this can be applied to entire simulators it is usually applied to outfitting components of simulators (valves, knobs, switches, lights, etc.). For example, a payload simulator may have a requirement to be a class IIb simulator (hardware panels driven by a software model), while the hardware panels on that simulator may contain components that are of higher or lower fidelity than the overall designation of the simulator itself. The simulator may have a panel containing a door to a chamber which does not open. The chamber door is then classified as a III.C component. Due to the degree of crew interaction with a built in display/keypad on that same panel, a flight type keypad is used. Thus, the display/keypad is a I.A component.

TABLE B-I SIMULATOR COMPONENT FIDELITY

CLASS\FUNCTIONALITY	F. FLIGHT TYPE	A. FUNCTIONALLY ACTIVE	B. OPERABLE	C. STATIC
Flight Article	Flight equipment downgraded for training or not Certified	N/A	N/A	N/A
I.: Flight assembly tolerance Similar material Exact configuration	N/A	I.A	I.B	I.C
II.: Relaxed assembly tolerance Mixed material Approximate Configuration	N/A	II.A	II.B	II.C
III.: Approximate Dimensions Optional material Approximate configuration	N/A	III.A	III.B	III.C

The SSTF/PTC has the following interpretation of the categories listed above:

A: Replicates the active user interface of the analogous payload hardware, controls and displays, and interact with the system models. Controls operate in the same "sense" as the flight article.

B: Hardware without a Signal Conversion Equipment (SCE) interface. This applies generally to mechanical hardware without a systems interface.

C: Includes graphics or three dimensional objects added to aid in identifying or locating controls and displays.

I: Hardware matches flight article orientation, range of motion, display resolution, sound quality, color, texture and other relevant physical properties.

II: Hardware is three dimensional in an approximately correct relative orientation and are similar in appearance to the flight article. Size, exact color, and other physical properties not affecting the required functional fidelity may vary.

III: Hardware provides sufficient visual information to aid in locating controls and displays, without regard to flight article dimensions or materials. Controls and displays are packaged on flat panel assemblies and are capable of conveying the same information in the same general manner (lights-lights, dials-dials) as the flight article, but may vary in size, exact color, and other physical properties not affecting the required functional fidelity.

APPENDIX C

SIMULATOR CABLE CONNECTOR SPECIFICATIONS

(This Page Intentionally Blank)

C, SIMULATOR CABLE CONNECTOR SPECIFICATIONS

TABLE C-I *FIRST PANEL* DATA CABLE CONNECTOR SPECIFICATION

First Panel Connector Label:

First Panel Connector Type:

Mating Connector Type:

SSTF/PTC Destination:

PIN #	CONN. PIN GAGE AWG	FUNCTION	VOLT LEVEL	LOAD (A)	TYPE OF SIGNAL

(This Page Intentionally Blank)

APPENDIX D

PAYLOAD SIMULATOR INTERFACE DEFINITION FORMS

(This Page Intentionally Blank)

D, PAYLOAD SIMULATOR INTERFACE DEFINITION FORMS

Include the PSID forms that were initially provided by the PD and completed by the DK personnel in this section.

(This Page Intentionally Blank)